PUB-5416

Conceptual Design Report

Electrical Systems Rehabilitation, Phase IV - Blackberry Switching Station Replacement

February 1996

Project Number 98-LBL

Ernest Orlando Lawrence Berkeley National Laboratory
University of California, Berkeley, California 94720
Prepared for U.S. Department of Energy under Contract No. DE-AC03-76SF00098

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

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ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

SECTION 1

INTRODUCTION

Summary

The Blackberry Switching Station Replacement Project is a major element of an integrated plan to rehabilitate the Ernest Orlando Lawrence Berkeley National Laboratory's (Berkeley Lab) electrical power system, maintain its reliability and improve its safety. The project will upgrade the existing 12kV power system and utilize circuit breakers provided in the FY 87 MEL-FS project improvements of the main Grizzly Substation. It will also make available to the Blackberry Canyon Service Area the advantages of a dual feeder distribution system to provide service for critical operations and personnel safety. The electrical system of the Blackberry Canyon Service Area distributes power to a group of nineteen major buildings as shown on drawing E-1 of this report. This project conforms to the electrical utilities plan set forth in the 1994 Berkeley Lab Integrated Facilities Plan.

The scope of work includes

- Installation of the new Blackberry Canyon Switching Station, a 12kV switching station to be located at the existing Building 51 Substation.

- New primary selective dual 12kV feeders installed in new ducts from the main Grizzly Substation to the new Blackberry Canyon Switching Station. The dual feeders configuration from the main substation will increase system reliability.

- New 12kV distribution circuits installed in new and existing ducts from the new Blackberry Canyon Switching Station to the facilities within the Blackberry Canyon Service Area.

- Elimination of the old (1948) "Big C" Switching Station, which is functionally obsolete and inefficient in its present location for service to the Blackberry Canyon Service Area.

- Elimination of all old 12kV cables between the Grizzly Substation and the Blackberry Canyon Service Area.

- Elimination of 12kV switchgear within Building 51 which is underrated and obsolete. The new Blackberry Canyon Switching Station will replace its function.

- Removal or replacement of underrated switching equipment, ungrounded 480 V load centers, and consolidation of loads in the Buildings 51/64 area.

- Installation of two (2) new secondary unit substations with grounded 480 V secondaries to serve buildings presently connected to the Building 51 distribution system.

- Installation of a new secondary unit substation with grounded 480 V secondary to serve Building 55 area.

- Removal or replacement of aged transformers and/or switching equipment at Buildings 71 and 88.

- Installation of a new secondary unit substation with grounded 480 V secondary to serve Building 71, replacing aged equipment.

- Replacement of aged 12kV switching type power correction capacitor banks at Big C Switching Station and Building 51 with 480 V static capacitor banks at each new load center to provide correction at the utilization level.

Project Justification

This project will correct existing deficiencies in the power distribution system that serves the Blackberry Canyon Service Area. The improvements will replace the existing electrical system, which consists of aged and underrated electrical equipment that is difficult to maintain and unsafe to operate. It will provide Berkeley Lab with increased operational flexibility as well as improvements in reliability, maintainability and safety. The existing service equipment is more than 30 years old in most instances, with some equipment over 40 years old.

Need to Retire the Big C Switching Station

This new project will permit retirement of the remaining portion of the aged Big C Switching Station, which is located west of Building 10 and midway between the Main Grizzly Substation and the site of the new Blackberry Canyon Switching Station. Three of its four buses serve loads in the Blackberry Canyon Service Area. This switching station was first installed in 1948 when the Berkeley Lab was fed by three feeders from the University of California, Berkeley campus. At the time of its construction, it served the useful function of providing switching flexibility so that the regulated and unregulated Bevatron loads and the 184-Inch Cyclotron loads could be served with any two of the three incoming campus feeders.

In 1957, as a result of the need for more power capacity, the Grizzly Substation was constructed to serve as the primary receiving station for Berkeley Lab. While the Big C Switching Station was then rendered functionally obsolete as the primary receiving station, it was reconnected to receive service from the new Grizzly Substation through three new supply feeders. This arrangement provided an additional switching point between the utility supply and load uses and increased the complexity of maintenance procedures. Since 1957 the Big C Switching Station has continued its traditional switching and voltage regulating functions. However, the physical location of the Big C Switching Station does not provide any meaningful function or enhancement to the configuration of the system; instead, it precludes primary supply to the Blackberry Canyon Service Area over an independent right-of-way.

The existing Big C Switching Station was built with metal enclosed switchgear installed over a shallow, covered trench. It serves a large number of facilities in addition to Blackberry Canyon Service Area. A massive aggregate of cables in the covered trench effectively precludes inspection and access to individual cables. Since there is no circuit redundancy, any maintenance on the Big C switchgear requires a complete shutdown of all 12 kV circuits, causing power outages for a large number of buildings in the area served by Big C. With these operational constraints, scheduled maintenance has been minimal. Also, because the short-circuit availability from Bank 2 at Grizzly Substation has increased recently due to the installation of a campus cogeneration plant, the existing 500 MVA equipment at Big C is now underrated and requires replacement to mitigate safety hazards.

Supply feeders that formerly terminated at the Big C have been eliminated because of the introduction of the double-bus system at Grizzly Substation. This and the factors previously discussed are reasons for abandoning the Big C Switching Station. Eliminating the Big C Switching Station will also facilitate preventive maintenance monitoring not possible with the current configuration. For example, a diagnostic cable testing program could be implemented by opening circuit breakers at both ends of each feeder, completely isolating the power feeders.

Once equipment has been removed from the switching station, its pad, trenches, and fencing can be removed and the site restored to match the natural surroundings.

Need to Retire the Building 51 12 kV Switching Station

The existing 12 kV switching station at Building 51 is rated 500 MVA. It is now underrated and requires replacement to mitigate safety hazards. The switching station uses obsolete air-magnetic circuit breakers which are not equipped to provide ground fault protection to its feeders. Because of the shutdown of the Bevatron's operations at Building 51, the switchgear line-up is largely not required. Remaining active feeders will be reconnected to the new Blackberry Canyon Switching Station.

Need To Replace Primary 12kV Feeder Cables

The oldest of the existing cables in the circuits between the Grizzly Substation and the Blackberry Canyon Service Area were installed in 1955 and are subject to failure at any time. Additional circuits installed in 1965 will be 32 years old by FY 1997 and will reach the end of their expected useful life with the attendant increasing risk of failure. Consequently, all the 12kV cables providing power to Blackberry Canyon Service Area need replacement.

In the late 1960's a landslide near the Big C Switching Station severed the 12kV feeders to the Blackberry Canyon area. This required resplicing of two (2) existing 500 kcmil feeders. To expedite repairs, two (2) 300 MCM conductors per phase were installed in each of the feeders, resulting in a mismatch of cable ampacities. This situation also resulted in the inefficient use of extra underground conduits, the use of which will be regained by installing a new uniformly sized cable system.

The new unit substation for the National Energy Research Super Computing Center (NERSC) is currently fed from the old main cabling system. Any downtime due to main feeder failure will cause revenue and database loss to the Laboratory. This rehabilitation will replace existing old cables and provide dedicated dual main feeders to the NERSC substation, enhancing reliability and maintainability.

Need to Replace Ungrounded 480 V Load Centers

The existing 480-V load centers at Buildings 51, 55, and 71 have ungrounded secondary distribution systems. Ground fault detection and alarm systems exist, but a ground condition creates personnel hazards and unsafe conditions. The occurrence of a second ground fault on the system will cause a widespread power outage in these facilities and possible harm to personnel and/or damage to equipment. Solidly grounded 480Y/277-V power distribution to these buildings will provide safe and reliable operation, and proper ground fault protection to isolate faults with minimal damage to the equipment and cabling. The replacement of the existing load centers will also decommission an old freon-cooled transformer and switching equipment.

The transformer primary voltages of some of the load centers are rated at non-standard voltages. The new load centers will all operate at 12.47 kV. By operating all load centers with the same rated primary voltage, the need to relocate the voltage regulators at the Big C Switching Station is eliminated, and operation of the primary distribution system is simplified and more reliable.

Power-factor-correction capacitor banks will be installed with the new load center equipment. This will replace the 12-kV power-factor-correction banks at the Big C Switching Station and the Building 51 Substation. The existing capacitor banks are aged and in poor condition. Capacitor banks operating at the 480-V level will be more effective, being closer to the loads, physically smaller, and easier to maintain.

Need for New Blackberry Switching Station

The lack of individual fault protection for each feeder circuit is a critical limitation in the existing power distribution system. Examples include the "tee-tapped" feeders leaving Big C Switching Station and use of the same Bevatron circuit to serve Building 90 Substation and Bank 112 at Blackberry Substation #2 (which serves the External Particle Beam Hall and the Building 55 Biomedical Complex). A ground fault anywhere on one of these circuits will open the main circuit breaker at Grizzly Substation, resulting in widespread loss of power.

CAMP and RPM Ratings

This project was rated using the Capital Asset Management Process (CAMP) evaluation criteria and achieved a 72.7 CAMP score. The CAMP criteria relates primarily to health and safety, mission and investment, environmental and waste management, and security and safeguard needs. The primary subcategory for the

Blackberry Switching Station Replacement Project was Health and Safety, because of the safety hazards associated with the existing inadequate switchgear, wiring and conduit systems. Because health and safety is the primary driver for the project, it was also rated using the Risk-Based Priority Model (RPM). The project achieved an RPM score of 349 due to the high risks posed by the existing electrical distribution system. These risks include disabling or fatal injury, noncompliance with current electrical codes, and unscheduled electrical service outages that disrupt mission performance and create investment losses.

Summary of Needs and Justification

In summary, the construction of the new Blackberry Switching Station will provide the following benefits to Berkeley Lab:

- Aged and underrated electrical equipment in the power system that feeds the Blackberry Canyon Service Area, which is unsafe to operate, will be replaced.

- The primary selective system design of the new facility will greatly improve normal operations and maintenance procedures and operational flexibility, and increase reliability of the main power supply as a result of the new station being located in close proximity to loads .

- Fault protection and means of disconnection for each feeder will provide isolation without shutting down unrelated circuits to other facilities. This will mitigate scheduling difficulties for maintenance and repairs on the system.

- The replacement of 12kV primary feeders, many of which have reached the end of their useful life, will eliminate mismatched cables, which are inefficient and use extra duct space.

- Power factor correction will be more efficient, being closer to the loads.

- The substandard and aged equipment at the Big C Switching Station will be retired. The Big C support structure will be removed and the site restored to a natural state.

- Removal of load centers with ungrounded secondary distribution systems or replacement with solidly grounded secondary distribution systems will provide personnel and equipment protection from ground faults.

Basis of Conceptual Design

Determination of Operational Requirements

Basic criteria and operational requirements were assembled by the Berkeley Lab Facilities Department. Engineering data and other technical evaluations of the project were prepared by the Facilities Department engineering staff with the aid of specialized consultants.

YEI Engineers, Inc. assisted in the evaluation of existing cable systems and selection of specific items of equipment and provided construction cost estimates, drawings and outline specifications. The Facilities Department professional cost estimator reviewed estimates prepared by YEI Engineers, Inc.

Selection of Proposed Improvements

The proposed improvements to the electrical utility system are those most urgently needed to rehabilitate and improve the system. Specific improvements were selected after thorough investigation of the existing distribution system and review of plans for current projects under design or in the planning stage. Information was obtained from record drawings and historical data on system-wide and local power outages.

This report includes drawings of those portions of the 12kV system requiring new power feeders and replacement of existing equipment. Also, Berkeley Lab maintenance personnel provided knowledge of deficiencies, operating problems and desirable improvements to the system. This information was used to pinpoint system malfunctions, determine the greatest potential for system failure, and find where changes or additions could enhance reliability and efficiency. Construction planning information was used to determine how future projects will affect the distribution system and what improvements should be made now to most efficiently accommodate future expansion.

Method of Performance

Engineering and Design

Berkeley Lab will assign a project manager who will be responsible for managing the project and reporting status data relative to schedule and cost. All subcontractors will be required to prepare and maintain current schedules and budget plans for their work.

A design program will be prepared by the Berkeley Lab Facilities Department to provide direction to an Architect-Engineer firm. It will include project scope and schedule requirements and design criteria for all aspects of the site work, utilities, special facilities and equipment to be included in the construction Subcontract documents.

An Architect-Engineer firm experienced in this type and size project will be selected, and a lump-sum Subcontract will be negotiated and awarded by the University. Contract administration will be accomplished by the Berkeley Lab Purchasing Department. Inspection of construction will be accomplished by the Berkeley Lab Facilities Department.

Some minor design of alterations and modifications to existing utilities will be accomplished by Berkeley Lab.

Construction and Procurement

Major construction will be carried out under a lump-sum Subcontract award after competitive bidding.

Some work associated with tie-ins and start-up may be accomplished by Berkeley Lab crafts to ensure operational continuity.

Procurement of special facilities will be accomplished through competitive procedures.

Phasing Considerations

Construction involved with the Blackberry Switching Station Replacement Project has been planned and scheduled to mitigate program disruptions through careful sequencing of the work.

Innovative Technologies in Design and Construction

The execution of the project includes innovative processes and technologies to reduce the delivery time for design and construction and minimize operations and maintenance costs of the completed project. Design features include products with increased durability and systems that provide substantial operating flexibility.

A reduction in design document delivery time will be achieved through the use of the consulting engineering firm and personnel that were previously hired for earlier phases. By modifying the existing specifications and drawings from Phases I, II & III of the Electrical System Rehabilitation, design effort for this phase (Phase IV) is significantly reduced. This approach will minimize the designers "learning curve" for this project and shorten the time needed for preparation of documents.

Procurement of the electrical equipment by Berkeley Lab will shorten the construction duration by allowing the ordering of equipment after completion of Title I, rather than after award of the construction subcontract. This will move the submittal review and equipment fabrication activities earlier in the project schedule and reduce the overall project schedule by approximately one year.

Use of the sole-source process for procurement of the electrical equipment will allow Berkeley Lab to specify new electrical switchgear and substation equipment that matches existing electrical equipment at the Laboratory. This will ensure compatibility between equipment and will reduce required training, parts inventory and maintenance costs. Specifications will call for vacuum circuit breakers and solid-state relays, which require less calibration and parts replacement, thereby saving operations, maintenance and energy costs. Substation transformers will be specified to be of the dry-type, cast-coil design with an 80°C rating to ensure high-efficiency operation and easier maintenance, which results in lower life cycle costs compared to typical liquid filled transformers. Also, the use of the dry-type, cast-coil transformers will remove the risk of contamination from transformer oil leakage, and reduce design and construction costs, since oil containment measures will not be necessary. Operation and maintenance costs will be further reduced because the switchgear and substation equipment will be monitored and controlled with the Laboratory's Supervisory, Control and Data Acquisition (SCADA) system. Continuous monitoring will assist in preventing distribution system problems, and if failures occur the SCADA system will aid in troubleshooting and initiating quick corrective action.

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

SECTION 2

PROJECT DESCRIPTION

General

The purpose of this project is to replace the existing aged and unsafe electrical equipment and cable plant that serves the Blackberry Canyon Service Area with a modern system that can be efficiently maintained and operated.

Blackberry Canyon Switching Station

The new switching station will be sited at the existing substation of Building 51, centrally located to serve the Blackberry Canyon Service Area.

The new station switchgear will house two main buses (each with a main circuit breaker) and a tie circuit breaker between the two main buses. The switchgear will carry Grizzly Substation Bank 1 power on Bus 1 and Grizzly Substation Bank 2 power on Bus 2. Bus 1 will carry pulsed loads while Bus 2 will carry power for non-pulsed loads. With pulsed loads, the line voltage is subject to transients and fluctuations. Berkeley Lab's design and operational philosophy is to separate pulsed and non-pulsed loads, and this concept is carried through in this conceptual design.

The new switchgear will consist of a double-ended, metal-clad switchgear housed in an outdoor metal enclosure of protected-aisle design. The circuit breaker control sections will be furnished with a full complement of instrument transformers, protective devices, indicating meters, and a data acquisition system. The switchgear will be rated at 13.8 kV, 1200 A, 3-phase, 60 Hz, 750 MVA. The switchgear will have an 125 VDC station battery system for circuit breaker control and circuit protection. A remote terminal unit provided to allow monitoring and control of the switching station by the Laboratory's Supervisory, Control and Data Acquisition (SCADA) System.

The new switching station will be provided with fencing, outdoor area lighting, and telephone and communications circuits.

New Primary Circuits

This project will provide for two new circuits from the existing Grizzly Substation to the new Blackberry Canyon Switching Station. Each circuit will consist of six (6) 750MCM 15-kV cables routed through a new installation of duct banks and manholes in the McMillan Road area. These right-of-ways are shown on drawing E-5.

Dual 15 kV feeder circuits of various cable sizes will leave Blackberry Canyon Switching Station and go to new and existing secondary unit substations or sectionalizing switches within the service areas. Routing of the feeders will be through new and existing ductbanks and manholes.

Capacitor Banks

Existing aged 3 MVAR, 12 kV switching type power correction capacitor banks at Big C Switching Station and Building 51 Substation will be replaced with 480V static capacitor banks at each new load center to provide power factor correction at the utilization voltage. Removal of the 12 kV switching capacitors will eliminate voltage surges under light loads, and will also free up two (2) 13.8 kV circuit breakers in the new Blackberry Canyon Switching Station for future use.

New Secondary Unit Substations

Two (2) new secondary unit substations will be installed at Building 51 to serve Buildings 51, 63, and 64. The existing Building 51 Substation pad and trench system will require minor modifications for the installation of the new equipment and cables.

A new secondary unit substation will be installed near Building 55 to serve Buildings 55, 55A, 56, 60, and Blackberry Canyon trailers. This unit substation will reuse the Blackberry Substation #2 pad with minor modifications to connect to new and existing ductbanks.

A new secondary unit substation will be installed at Building 71 to serve Buildings 71, 71A, 81, 82, and Building 71 trailers. This unit substation will reuse the existing pad with only slight modifications for the installation of the new equipment and cables.

Each new secondary unit substation will consist of an outdoor, combination 13.8 kV selector/fused load interrupter switch, an outdoor, ventilated, 1500 kVA AA/FA cast-coil transformer, and a 480Y/277 V switchgear line up housed in a walk-in type outdoor enclosure. The new solidly grounded unit substations will be equipped with solid state monitoring and control systems to provide energy metering, circuit protection, circuit breaker control, and high voltage switch and transformer status. The new unit substations will be provided with fencing, outdoor area lighting, telephone and communications circuits as necessary.

New Building 88 Substation High Voltage Switch

The existing 15 kV fused load interrupter switch at Building 88 Substation will be replaced with a new outdoor, 15 kV selector/fused load interrupter switch.

APPLICABLE CODES AND DESIGN REFERENCES

Applicable requirements and recommendations in the following codes and references will be followed in the design. These codes, as listed, should be included in the construction specifications. Codes and references will be the latest editions except where specifically noted otherwise:

A. Codes

1. 10 CFR Part 435 Energy Conservation Voluntary Energy Performance Standards (Mandatory for Federal Buildings)
2. 29 CFR Part 1910, Occupational Safety and Health Standards, Department of Labor
3. 29 CFR Part 1926, Safety and Health Regulations for Construction, Department of Labor
4. 36 CFR Part 1191, Architectural and Transportation Barriers Compliance Board
5. 40 CFR Parts 264 and 265, Environmental Protection Agency
6. National Fire Codes, National Fire Protection Association (NFPA)
7. National Electrical Safety Code, ANSI C2
8. National Electric Code, NFPA 70
9. Safety Code for Building Construction, ANSI A10.2
10. California Code of Regulations, Title 8, General Industrial Safety Orders, Construction Safety Orders
11. California Code of Regulations, Title 19 - Public Safety, Chapter 1; Title 24, Part 2 - California Building Code; and Title 24, Part 3 - California Electrical Code
12. California Energy Code
13. Uniform Building Code/California Building Code
14. Uniform Mechanical Code
15. Uniform Fire Code
16. Uniform Plumbing Code
17. Occupational Safety and Health Act
18. Federal, state, and local air-pollution and water-pollution control regulations
19. AMCA Fan Test Code
20. NBSIR 78-1305A Test Procedures
21. LBNL Lateral Force (Wind and Earthquake) Criteria

B. Design References

1. LBNL Design Management Procedures Manual
2. LBNL Long Range Site Development Plan
3. American National Standards Institute (ANSI) Standards
4. National Electrical Manufacturers' Association (NEMA) Standards
5. Institute of Electrical and Electronics Engineers (IEEE) Standards
6. Underwriters' Laboratories, Inc. (UL) Standards and "Building Materials, Fire Protection Equipment, and Fire Resistive Directories"
7. Factory Mutual Engineering Corp. (FM) Approval Guide and FM Loss Prevention Data
8. Insulated Cable Engineers' Association (ICEA) Standards
9. National Electrical Testing Association (NETA) Standards

QUALITY ASSURANCE PROCEDURES FOR DESIGN, CONSTRUCTION, FACILITY ACCEPTANCE AND PROJECT CLOSEOUT

Quality assurance procedures during project development, design, and construction assure that all safety, operational and Subcontract requirements will be met. The established system to review, inventory, and document facility construction, acceptance, and project closeout includes the following elements:

- Engineering
  - The LBNL Facilities Department, assisted by selected consultants, provides quality control and assurance measures during design and construction.
  - The Architecture and Engineering Group of the Facilities Department includes multidisciplinary design and project management sections. Each significant project is assigned to a Project Manager (PM) who is responsible for the management of cost, scope and schedule. The PM is also responsible for quality assurance during project formulation and implementation, and is assigned a staff that includes a design coordinator (the Technical Coordinator, or TC), a multidisciplinary design support team, a construction manager if necessary, a contract administrator, and a construction inspector. The TC is responsible for design and technical quality control. The work of each member of the TC's support team is reviewed by the appropriate discipline Section Chief. The PM develops a Project Management Plan that is reviewed and approved by Facilities Management and DOE/OAK.
  - Design and cost estimates are reviewed, and a plan check is carried out by LBNL, at completion of schematics and during and after Title I and Title II designs are completed. An independent third party plan check is made of the seismic design, and an independent cost estimate is made by a consulting cost estimator at completion of Title I and Title II to compare with the A&E's cost estimate. Plans and specifications are also reviewed by the LBNL Fire Marshal, the LBNL Environment, Health and Safety (EH&S) Division, the LBNL Energy Conservation Engineer, and the LBNL Facilities Maintenance and Operations Group at each stage of design development. When applicable, a consulting geotechnical firm provides appropriate geotechnical data and reviews the design at each stage of design and during construction.
  - An internal sign-off sheet covering all LBNL design disciplines, TC, PM, Fire Marshal, EH&S, Facilities Management, third party reviews, and the Client is completed at the end of Title I, Title II and Title III. (A sample form follows.)
- Construction
  - Subcontract documents are reviewed by LBNL's technical staff for compliance with DOE and LBNL design criteria.

- The Construction Inspector reviews, and the Executive Architect and Engineer (A&E of Record) and Facilities' staff of engineers accept or reject, all materials and workmanship in accordance with Subcontract documents.

- A submittal control system for materials, shop drawings, test reports, and certifications assures that all necessary reviews for compliance with specifications, codes, environmental mitigation measures and other requirements—including provisions for the handicapped and energy conservation—have been made.

- A Construction Inspector observes construction activities and reports discrepancies to LBNL's Project Manager (or Construction Manager, if applicable) and the TC. Daily inspection reports are maintained in a file or a project logbook.

- A Contract Administrator (from the Purchasing Department) reviews documentation for compliance with Subcontract provisions.

- A Safety Inspector (from LBNL's Environment, Health and Safety Division) and the Fire Marshal make periodic inspections of construction to assure compliance with safety and fire codes and regulations.

- Specialty inspections are made of rebar, structural steel, welding, concrete, and geotechnical conditions to assure compliance with codes and specifications. Appropriate testing laboratories are utilized for support as necessary. The A&E of Record is required to inspect the construction during appropriate times and provide interpretation of the Subcontract documents whenever necessary.

- Subcontract Change Orders

  - Reviewed in accordance with UC-LBNL Construction Subcontracting Manual.

  - If project contingency funds are involved, the proposed change is reviewed to ensure that it is due to unforeseen, uncertain, and/or unpredictable conditions or incomplete design.

- Final Inspection and Acceptance

  The following items are accomplished by the Inspector and the A&E of Record working together:

  - Preliminary inspection and list of incomplete work.

  - Equipment testing and operational instruction of LBNL personnel.

  - Final inspection walk-through and punch list.

  - Inspection of correctional and completion work (punch list work).

- Inventory of all operational manuals, instructions, guarantees.

- Internal sign-off sheet: Acknowledgment of completion and acceptance of all work under construction Subcontract by the LBNL project team and all interested parties; i.e., Fire Marshal, EH&S, etc.

- Subcontract Change Orders

  - The LBNL A&E team and Executive Architect and Engineer review any proposed change and provide justification and an independent cost estimate. The Subcontractor's proposed cost is evaluated relative to LBNL's cost estimate, and a Subcontract price is negotiated. Availability of project funds is verified. If all project and Subcontract requirements are met, a Change Order is executed.

- Project Closeout

  - After final acceptance of the facility, LBNL audits all charges to assure that all costs are in proper accounts.

  - LBNL sends the cost closing statement to DOE/OAK.

  - Project authorization closed by DOE/OAK.

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

SECTION 3

BASIS OF COST ESTIMATE

The cost estimate for the construction was prepared by YEI Engineers Incorporated, based upon quantity take-offs from conceptual design drawings and specifications, and was reviewed by the Berkeley Lab Facilities Department estimator.

Cost estimates are dated December, 1995, and represent current prices. Summary cost estimates are included in this section. Detailed cost estimates are included in Section 9. Escalation is based upon "Anticipated Economic Escalation Rates for DOE Construction Projects" updated January 1996 namely, 3.8% in FY 1995, 2.5% in FY 1996, 2.8% in FY 1997, 3.0% in FY 1998, 3.1% in FY 1999 and 3.3% in FY 2000. Escalation rates are compounded from December 15, 1994 to the midpoint of construction, December 31, 1999.

Cost estimates for equipment in Schedule I, Special Facilities, have been based upon prices for similar equipment purchased in 1995.

Cost estimate details for ED&I are located at the end of Section 9. Both the Estimate Summary shown in this section and the Detailed Cost Estimate in Section 9 have been correlated with the Work Breakdown Structure (WBS) shown in the BA/BO Schedule.

DEPARTMENT OF ENERGY
FY98 FIELD BUDGET REQUEST

ENERGY SUPPLY RESEARCH & DEVELOPMENT: PLANT & CAPITAL EQUIPMENT
MULTIPROGRAM ENERGY LABORATORIES - FACILITY SUPPORT
(Tabular dollars in thousands. Narrative material in whole dollars.)

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1. Title and Location of Project: Electrical Systems Rehabilitation, Phase IV - Blackberry Switching Station Replacement
Ernest Orlando Lawrence Berkeley National Laboratory
Berkeley, California

2a. Project No. 98-LBL
2b. Construction Funded

3a. Date A-E Work Initiated (Title I Design Start Scheduled): 2nd Qtr. FY 1998

3b. A/E Work (Titles I & II) Duration: 15 months

5. Previous Cost Estimate:
Total Estimated Cost (TEC)--none
Total Project Cost (TPC)--none

4a. Date Physical Construction Starts: 3rd Qtr. FY 1999

4b. Date Construction Ends: 4th Qtr. FY 2000

6. Current Cost Estimate:
TEC--$6,500
TPC--$6,540

7. Financial Schedule (Federal)

Fiscal Year	Appropriations	Adjustments	Obligations	Costs
1998	$ 2,400	$0	$ 2,400	$ 400
1999	4,100	0	4,100	3,400
2000	0	0	0	2,700

1.	Title and Location of Project:	Electrical Systems Rehabilitation, Phase IV - Blackberry Switching Station Replacement Ernest Orlando Lawrence Berkeley National Laboratory Berkeley, California	2a. Project No. 98-LBL 2b. Construction Funded

9. Details of Cost Estimate

			Item Cost	Total Cost
a.	Design and Management Costs			$ 1,130
	1.	Engineering, design, and inspection (@ ~20% of Construction Costs, Item c)	$ 870	
	2.	Construction management costs	0	
	3.	Project management (@ ~6% of Construction Costs, Item c)	260	
b.	Land and Land Rights			0
c.	Construction Costs			4,360
	1.	Improvements to land	$ 50	
	2.	Buildings	0	
	3.	Other structures	0	
	4.	Utilities	2,650	
	5.	Special facilities (Schedule I, Engineered Equipment)	1,660	
d.	Standard Equipment			0
e.	Major Computer Items			0
f.	Removal Cost Less Salvage			0
g.	Design and Project Liaison, Testing, Checkout and Acceptance			0
h.	Subtotal (a. through g.)			$ 5,490
i.	Contingencies (@ ~18% of above costs)			1,010
j.	Total Line Item Cost [Section 11.a.1.(a)]			$ 6,500
k.	LESS: Non-Federal Contribution			0
l.	Net Federal total estimated cost (TEC)			$ 6,500

Conceptual design is complete. Construction costs have been escalated at 3.2% for FY95, 2.5% for FY96, 2.8% for FY97, 3.0% for FY98, 3.1% for FY99, and 0.8% for FY2000 compounded to midpoint of construction, January 2000, for a total of 16%.

1. Title and Location of Project:	Electrical Systems Rehabilitation, Phase IV - Blackberry Switching Station Replacement Ernest Orlando Lawrence Berkeley National Laboratory Berkeley, California	2a. Project No. 98-LBL 2b. Construction Funded

SCHEDULE I

Special Facilities

Power switchgear 13.8 kV, 1200A, 750 MVA	$ 740
125 V Station Battery	20
Data Acquisition System	20
Disconnect Switch 15 kV, 600A	20
Secondary Unit Substation, 1500 kVA, 12.47 kV-480/277V - 4 each	860
	$1,660

The above costs have been escalated to the midpoint of construction as indicated in Item 10.

1.	Title and Location of Project:	Electrical Systems Rehabilitation, Phase IV - Blackberry Switching Station Replacement Ernest Orlando Lawrence Berkeley National Laboratory Berkeley, California	2a. Project No. 98-LBL 2b. Construction Funded

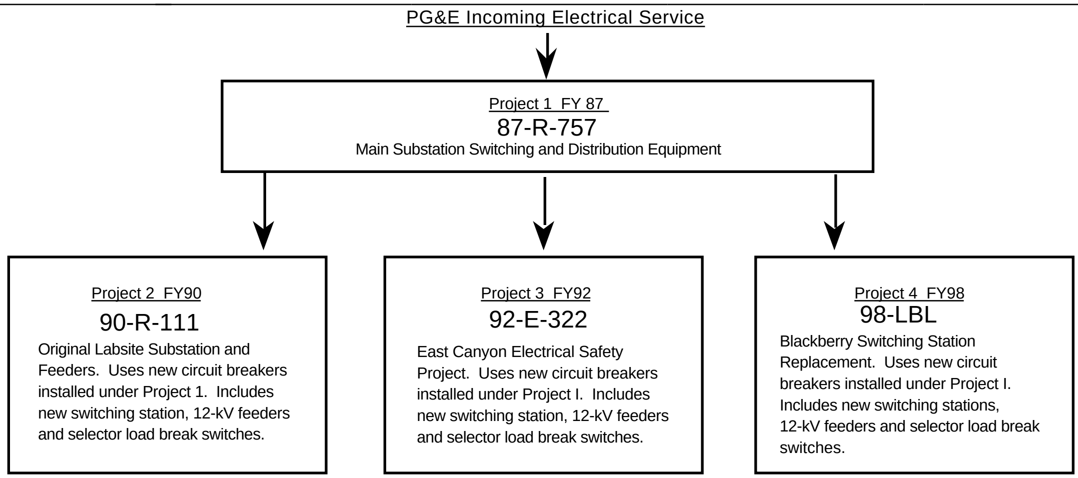


Figure 1: Berkeley Lab electrical system long range plan.

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

ESTIMATE SUMMARY
($K)

	Improvements to Land	Construction	Procurement	Total
Construction Cost Estimate	40	1,851		
Subcontractor OH & Profit 11%		204		
Berkeley Lab Purchased Electrical Equipment	__	______	1,283	
Subtotal	40	2,055	1,283	3,378
+ General Conditions 8%		164		164
+ Procurement Contingency		Included in Equipment Cost		
+ Estimating Contingency	__	Included in Project Contingency		
Subtotal	40	2,219	1,283	3,542
+ Bond at 2%	__	45	______	45
Subtotal	40	2,264	1,283	3,587
Construction Escalation to Midpoint of Construction, December, 1999~16%*	6	362	205	573
Subtotal	46	2,626	1,488	4,160
Berkeley Lab Overhead	4	24	172	200
Construction Costs	50	2,650	1,660	4,360

* Costs have been Escalated to the Midpoint of Construction at the Following Percentages: FY 1995 3.2% (10 months), FY 1996 2.5%, FY 1997 2.8%, FY 1998 3.0%, FY 1999 3.1% and FY 2000 .8% (3 months), for a Total of 16.4%

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

COST SUMMARY
($K)

ITEM	EQUIPMENT	MATERIAL	LABOR	TOTAL
Blackberry Switching Station	602		66	668
Building 51 Substation	337		36	373
Building 71 Substation	169		16	185
Building 55 Substation	156		15	171
Building 88 Substation	19		3	22
Miscellaneous Station Systems		19	16	35
Demolition			94	94
Manholes		52	19	63
Ductbanks		354	337	731
New 12 kV Feeders		629	195	824
Sub-Total	1,283	1,054	797	3,134
General Conditions, Overhead, Profit and Bond		235	178	413
Subtotal	1,283	1,289	975	3,547
Improvements to Land				40
Subtotal				3,587
Escallation to December 1999				573
Subtotal				4,160
Berkeley Lab Overhead				200
Total				4,360

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

ESCALATION ANALYSIS

Based on DOE "Anticipated Economic Escalation Rates" (updated January 1996)

Start Construction:	April 1999
Construction Period:	18 Months
Finish Construction:	September 2000
Midpoint Construction:	December 1999
Latest Estimate:	December 15, 1994

														%		
FY	1995	Dec	1994	-	Sep	1995	10	mo	@	3.8	=	3.2
FY	1996	Oct	1995	-	Sep	1996	12	mo	@	2.5	=	2.5
FY	1997	Oct	1996	-	Sep	1997	12	mo	@	2.8	=	2.8
FY	1998	Oct	1997	-	Sep	1998	12	mo	@	3.0	=	3.0
FY	1999	Oct	1998	-	Sep	1999	12	mo	@	3.1	=	3.1
FY	2000	Oct	1999	-	Dec	1999	3mo		@	3.3	=	0.8

Total Compounded Escalation **16.4**

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV
BLACKBERRY SWITCHING STATION REPLACEMENT

98-LBL

OBLIGATIONS AND COSTS SCHEDULE DETAIL*
($K)

DESCRIPTION	TOTAL	FY 1998 O	FY 1998 C	FY 1999 O	FY 1999 C	FY 2000 O	FY 2000 C
LBL Activities							
Engineering	330	150	150	127	127	53	53
Inspection	170			57	57	113	113
Consultants	40			14	14	26	26
Subtotal	540	150	150	198	198	192	192
Architect/Engineer							
Title I & II	260	260	150		110		
Title III	70	70			24		46
Subtotal	330	330	150	0	134	0	46
Construction							
Site Improvements	50			50			50
Utilities	2,650			2,650	820		1,830
Subtotal	2,700			2,700	820		1,880
Special Facilities							
Engineered Equipment	1,660	1,430		230	1,660		
Project Management	260	40	40	100	100	120	120
Subtotal	5,490	1,950	340	3,228	2,912	312	2,238
Contingency (18%)	1,010	350	60	572	488	88	462
TOTAL	6,500	2,300	400	3,800	3,400	400	2,700

* Represents Berkeley Lab obligations and costs

3/22/96
O&C/BBC/PV

BLACKBERRY CANYON SWITCHING STATION REPLACEMENT
98-LBNL
BA/BO SCHEDULE ($K)

WBS NO.	WBS ELEMENT	TOTAL BUDGET	FY 1998 Q1 (O N D)	FY 1998 Q2 (J F M)	FY 1998 Q3 (A M J)	FY 1998 Q4 (J A S)	FY 1999 Q1 (O N D)	FY 1999 Q2 (J F M)	FY 1999 Q3 (A M J)	FY 1999 Q4 (J A S)	FY 2000 Q1 (O N D)	FY 2000 Q2 (J F M)	FY 2000 Q3 (A M J)	FY 2000 Q4 (J A S)
1														
1.1	Engineering, Design & Inspection													
1.1.1	LBL Activities													
1.1.1.1	Title I	100		50/50	50/50									
1.1.1.2	Title II	150				50/50	50/50	50/50						
1.1.1.3	Title III	80							14/14	13/13	13/13	13/13	14/14	13/13
1.1.1.4	Inspection	170							28/28	29/29	28/28	29/29	28/28	28/28
1.1.1.5	Consultants	40							7/7	7/7	7/7	6/6	7/7	6/6
1.1.2	Architect/Engineer													
1.1.2.1	Title I	100		100/50	0/50									
1.1.2.2	Title II	160		160/0		0/50	0/55	0/55						
1.1.2.3	Title III	70		70/0					0/12	0/12	0/12	0/12	0/12	0/10
1.2	Construction													
1.2.1	Improvements to Land	50							50/0				0/25	0/25
1.2.2	Utilities	2650							2650/320	0/500	0/505	0/505	0/500	0/320
1.2.3	Engineered Equipment	1660				1430/0		230/830		0/830				
1.3	Relocations	0												
1.4	Standard Equipment													
1.5	Project Management	260		10/10	10/10	20/20	20/20	20/20	30/30	30/30	30/30	30/30	30/30	30/30

WBS NO.		TOTAL BUDGET	FY 1998	FY 1999	FY 2000
	Subtotal	5490	1950 / 340	3228 / 2912	312 / 2238
1.6	Contingency by Year	1010/1010	350 / 60	572 / 488	88 / 462
	Total BA/BO by Year	6500/6500	2300 / 400	3800 / 3400	400 / 2700
	Current Funding Plan	6500	2400	4100	0

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

CONTINGENCY ANALYSIS

	Estimated Cost ($K)	Contingency (%)	Contingency ($K)
LBL Activities			
Engineering	330	15	50
Inspection	170	17	29
Consultants	40	15	6
Architect/Engineer			
Titles I & II	260	20	52
Title III	70	15	11
Construction			
Improvements to Land	50	12	6
Utilities	2,650	20	530
Special Facilities, Engineered Equipment	1,660	17	286
Project Management	260	15	40
Subtotal	5,490		1,010
Contingency ~18%	1,010		
TOTAL	6,500		

MAJOR COMPONENTS OF COST ESTIMATE

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV

BLACKBERRY SWITCHING STATION REPLACEMENT

		Base Cost	Escalated Cost @16%	Overhead/ Burden	Cost	Rounded
A.	**ED & I**	629	742		860	870
	1) ENGINEERING & DESIGN (IN HOUSE)	364	422	114	537	540
	Title I	68	79	23	102	100
	Title II	102	118	35	153	150
	Title III	51	59	17	76	80
	Inspection	110	128	37	165	170
	Consultants	33	38	2	40	40
	2) ENGINEERING & DESIGN (A/E)	265	307	16	323	330
	Title I	78	90	5	95	100
	Title II	128	148	8	156	160
	Title III	59	68	4	72	70
B.	**Construction**	3,587	4,161	198	4,359	4,360
	1) Improvements to Land	40	46	2	49	50
	2) Utilities	2,264	2,626	26	2,652	2,650
	3) Buildings	0	0	0	0	0
	4) Special Facilities	1,283	1,488	169	1,658	1,660
C.	**Project Management**	170	197	58	255	260
D.	**Standard Equipment**	0	0	0	0	0
	SUBTOTAL (A, B, C, & D)					5,490
	CONTINGENCY ~18%					1,010
	TOTAL ESTIMATED COST (TEC)					**6,500**

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

SECTION 4

BASIS OF PROJECT TIME SCHEDULE

It is assumed that project funding will be made available for commitments by Berkeley Lab on January 1, 1998.

Prior to that time Berkeley Lab will evaluate environmental conditions and prepare recommendations for NEPA documentation for DOE consideration beginning in November 1996 for completion by August 1997. It is anticipated that a categorical exclusion recommendation will be prepared for this project.

A/E selection will take place between February and November 1997 during which time the Design Program necessary for A/E fee negotiations and a Project Management Plan for DOE will also be completed.

A/E fee negotiations will take place between December 1, 1997 and January 1, 1998 contingent upon assurance by DOE/OAK that the project is in the FY 1998 budget.

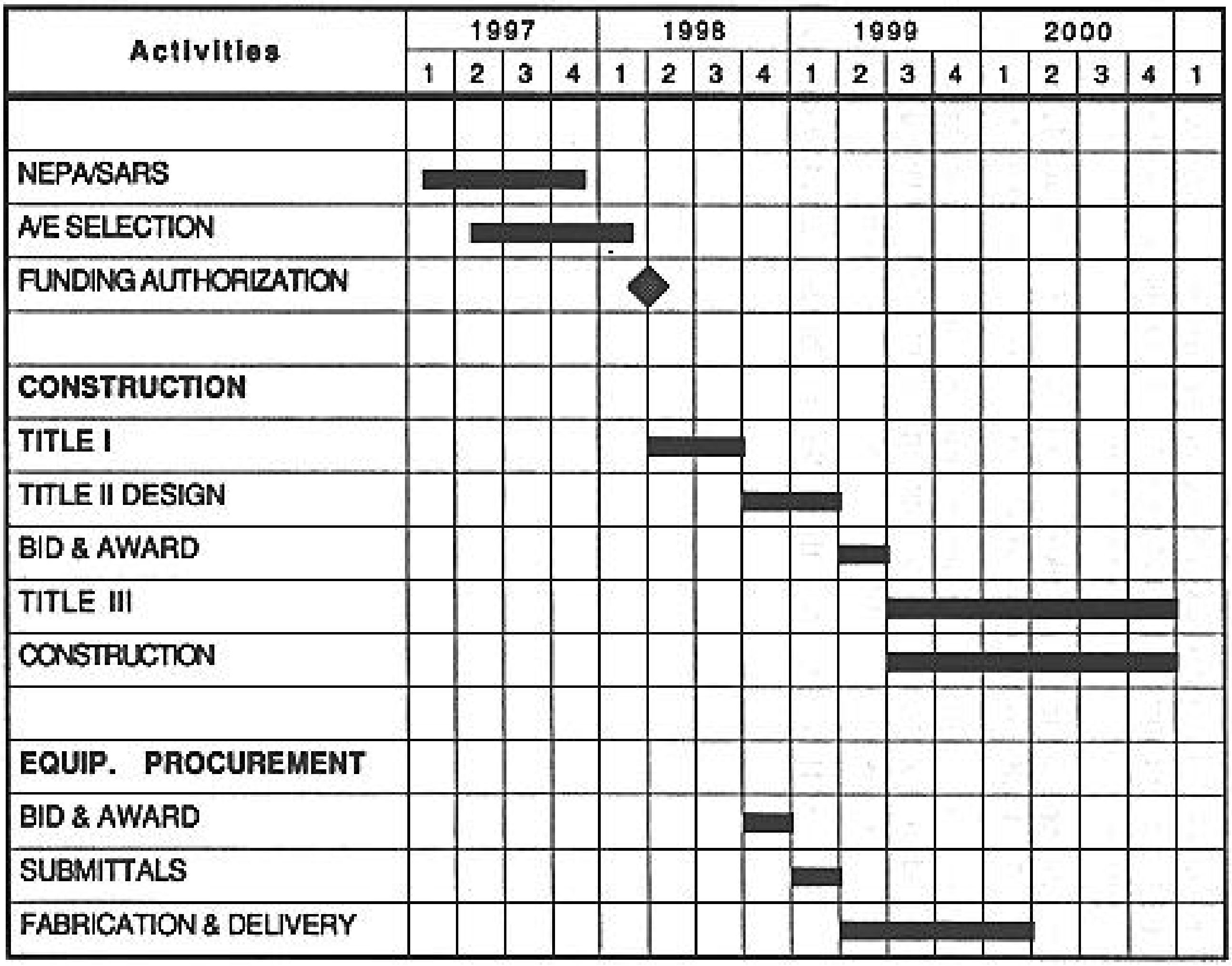
Alternative solutions including environmental considerations have been carefully studied in the process of developing this conceptual design, thus it is anticipated that the existing solution will be specified for A/E design.

The Project Time Schedule that follows is based upon the foregoing assumptions.

ELECTRICAL SYSTEMS REHABILITATION, PHASE 1V

BLACKBERRY CANYON SWITCHING STATION REPLACEMENT

TIME SCHEDULE



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ELECTRICAL SYSTEMS REHABILITATION, PHASE IV - BLACKBERRY SWITCHING STATION REPLACEMENT

SECTION 5

PROJECT DRAWINGS

E-1 SITE PLAN

E-2 EXISTING 12.47 kV SINGLE LINE DIAGRAM

E-3 PROPOSED 12.47 kV SINGLE LINE DIAGRAM

E-4 POWER DISTRIBUTION EQUIPMENT PLOT PLAN

E-5 DISTRIBUTION RACEWAY PLOT PLAN

E-6 BLACKBERRY SWITCHING STATION SW-A6 EQUIPMENT LAYOUT

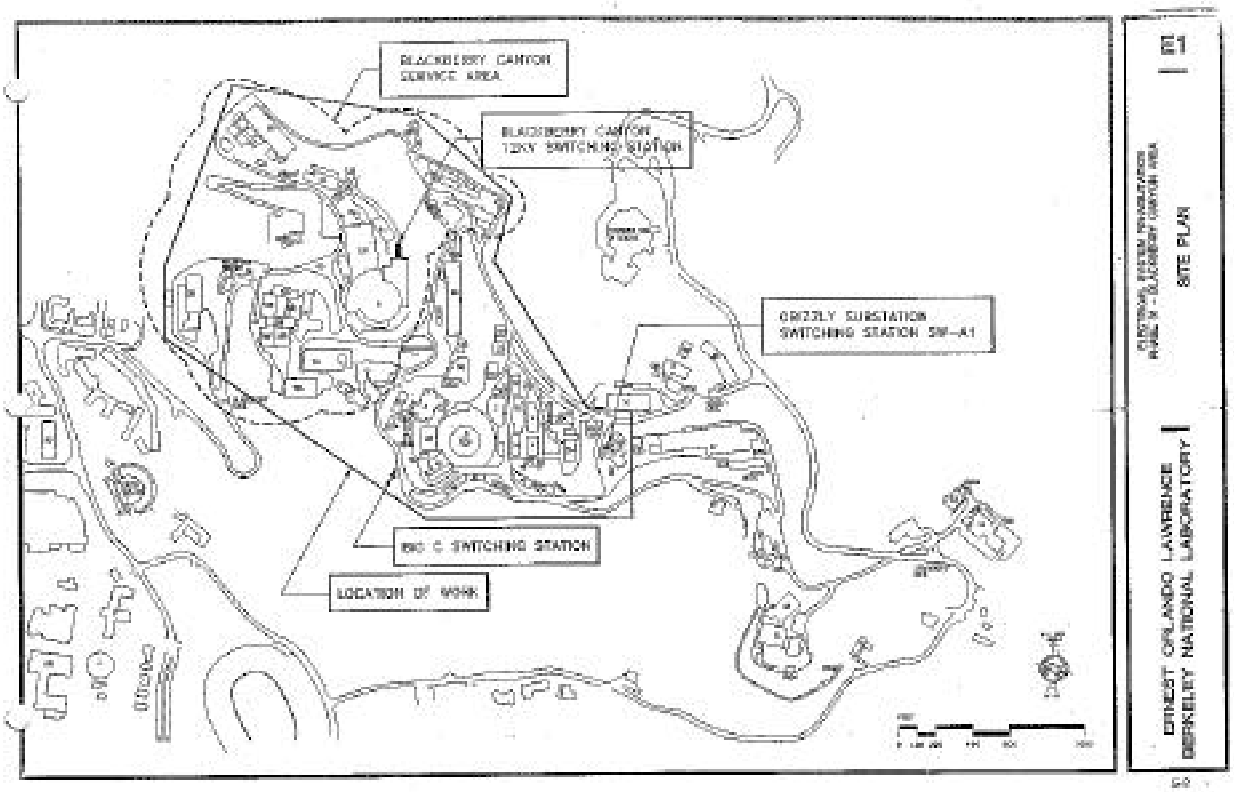
E-7 BLACKBERRY SWITCHING STATION SW-A6 EQUIPMENT ELEVATION

E-8 PROPOSED BLDG. 51 SUBSTATION MODIFICATION

E-9 PROPOSED BLDG. 55 AREA SUBSTATION AND BLDG. 71 SUBSTATION MODIFICATION

CABLE SCHEDULE - EXISTING FEEDERS (5 SHEETS)

CABLE SCHEDULE - NEW FEEDERS (3 SHEETS)


BLACKBERRY CANYON SERVICE AREA
BLACKBERRY CANYON 12KV SWITCHING STATION
GRIZZLY SUBSTATION SWITCHING STATION SW-A1
B80 C SWITCHING STATION
LOCATION OF WORK
ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY
SITE PLAN
E1

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-EXISTING FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	YEAR INSTALLED	LENGTH FT	REMARKS
F1	SW-A1-52-A105	GR CABLE VAULT SPLICE	GR SUB VAULT	6-350MCM	15kV	1988	60	CUT SPLICE & REMOVE (GR = GRIZZLY)
F1A	GR CABLE VAULT SPLICE	AD-3-C	EMH 10, 11, 8, 9, 7, 3, 2, 5	6-300MCM	15KV	1955	1,900	REMOVE (EMH = ELECTRICAL MAN-HOLE)
F2	SW-A1-52-A104	GR CABLE VAULT SPLICE	GR CABLE VAULT	6-350MCM	15KV	1988	60	CUT SPLICE & REMOVE
F2A	GR CABLE VAULT SPLICE	AD-4A-C	EMH 10, 11, 8, 9, 7, 3, 4	6-300MCM	15KV	1978	1,900	REMOVE
F3	RAD-5-C	RV-5-C	DIRECT	3-500MCM	15KV	1965	50	REMOVE
F4	RV-5-C	RAD-5-C	DIRECT	3-500MCM	15KV	1965	50	REMOVE
F5	RAD-6A-C	RV-6-C	DIRECT	3-500MCM	15KV	1965	50	REMOVE
F6	RV-6-C	RAD-6A-C	DIRECT	3-500MCM	15KV	1965	50	REMOVE
F7	AD-3A-C	EMH 12	EMH 6	3-500MCM	15KV	1965	425	CUT T-SPLICE & REMOVE
F7A	EMH12	ACB-S17-51	EMH 12, 24, 26, 35, 36, PB @B51	6-300MCM	15KV	1965	1,200	REMOVE (PB = PULL BOX)
F8	AD-5-C	ADF-1-BC	EMH 5, 4, 75, 77, 78, 59, 49, 48, 51, PB @BLACKBERRY SUB #1	3-500MCM	15KV	1965	2,300	REMOVE

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-EXISTING FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	YEAR INSTALLED	LENGTH FT	REMARKS
F9	AD-5-C	ACB-S159-51	EMH 4, 75, 77, 78, 59, 49, 48, 51, EPB TUNNEL, CABLE TRE-NCH @B51 SUB	3-500MCM	15KV	1965	2,600	REMOVE
F10	RAD-6A-C	EMH12	EMH6	3-500MCM	15KV	1965	425	CUT T-SPLICE & REMOVE
F10A	EMH 12	ACB-S12-51	EMH 24, 26, 35, 36, PB @B51	6-300MCM	15KV	1965	1,300	REMOVE
F14	ACB-S13-51	EMH 51	CABLE TRENCH@B51 SUB, EPB TUNNEL	3-300MCM	15KV	1957	540	CUT T-SPLICE & REMOVE (EPB=EXTERNAL PARTICLE BEAM)
F14A	EMH 51	ADF-3-BC	PB @ BLACKBERRY SUB #1	3-300MCM	15KV	1965	250	REMOVE
F14B	EMH 51	ADF-1-90	EMH 53, 54	3-#2AWG	15KV-VCL	1955	850	REMOVE (VCL=VARNISHED CAMBRIC LEAD COVERED)
F15	ACB-S14-51	EMH 79	WIREWAY/PB @B51, EMH 36, 35	3-#1AWG	15KV-VCL	1955	350	CUT T-SPLICE & REMOVE
F15A	EMH 79	OS-1-70	EMH 146	3-#1AWG 3-250MCM	15KV-PILC 15KV-EPR	1955 1965	60 200	CUT SPLICE & REMOVE PILC = PAPER INSULATED LEAD COVERED
F15B	EMH 79	ADF-1-50	4-INCH RISER	3-#2AWG	15KV-PILC	1955	30	CUT SPLICE & REMOVE
F16	FD-S16-51	3MVAR CAPACI-TOR BANK	WIREWAY & SUB. TRENCH @B51	3-250MCM	15KV	1965	200	REMOVE

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-EXISTING FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	YEAR INSTALLED	LENGTH FT	REMARKS
F17	SW-A1-52-A116	GR CABLE VAULT	DIRECT	9-350MCM	15KV	1988	60	CUT SPLICE & REMOVE
F17A	GR CABLE VAULT	ADF-1-C/ADF-1B-C BUS	EMH 10, 11, 8, 9, 7, 3 & 4	9-300MCM	15KV	1955	1,900	REMOVE
F18	ADF-1B-C	REA-1-C SW. OD-2-C	CABLE TRENCH	3-500MCM	15KV	1965	60	REMOVE
F19	REA-1-C SW. OD-2-C	3MVAR CAPACITOR	DIRECT	3-500MCM	15KV	1965	60	REMOVE
F20	RAD-1A-C	RV-1-C	DIRECT	3-500MCM	15KV	1965	60	REMOVE
F21	RAD-1A-C	RV-1-C	DIRECT	3-500MCM	15KV	1965	60	REMOVE
F22	ADF-4-C	EMH 77	EMH 6, 5, 4, 75	3-300MCM	15KV	1965	550	REMOVE
F23	EMH 77	GS-1-50B-A	EMH 78, 59	3-300MCM	15KV	1965	620	REMOVE
F24	GS-1-50B-B	ADF-2-50B-1	EMH59	3-350MCM	15KV	1996	200	TO BE INSTALLED IN NERSC PROJECT
F24A	ADF-2-50B-1	ADF-1-50B-1	EMH59	3-350MCM	15KV	1996	400	TO INSTALLED IN NERSC PROJECT
F25	GS-1-50B-C	GS-1-50A-B	EMH 59, 49	3-300MCM	15KV	1965	400	REMOVE
F25A	GS-1-50A-B	ADF-1-50A-1	DIRECT	3-300MCM	15KV	1965	90	REMOVE
F26	GS-1-50A-C	ADF-2-50B-2	EMH59,49	3-350MCM	15KV	1996	500	TO BE INSTALLED IN NERSC PROJECT
F26A	ADF-2-50B-2	ADF-1-50B-2	EMH59	3-350MCM	15KV	1996	400	TO BE INSTALLED IN NERSC PROJECT

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-EXISTING FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	YEAR INSTALLED	LENGTH FT	REMARKS
F27	GS-1-50A	EMH 48	EMH 49	3-500MCM	15KV	1965	120	CUT T-SPLICE & REMOVE
F28	EMH 48	ADF-1-88	EMH 56, 57, 58	3-500MCM	15KV	1965	1,020	REMOVE
F29	EMH 48	EMH 54	EMH 51, 53	3-500MCM	15KV	1965	825	CUT SPLICE & REMOVE
F30	EMH 54	OS-1-71	EMH 112, 111, 43	3-500MCM	15KV	1965	1,250	REMOVE
F31	OS-1-71	ADF-6-71	EMH 43, 117, 39	3-500MCM	15KV	1965	240	REMOVE
F32	ADF-6-71	OS-2-71-WAY C	DIRECT	3-500MCM	15KV	1965	40	REMOVE
F33	OS-2-71-WAY B	ADF-2-71	DIRECT	3-500MCM	15KV	1965	40	REMOVE
F34	SW-A1-52-A107	ADF-1-71	GR SUB VAULT, EMH 118, 93, 113, 114, 115, 115A, 116, 38, 43, 39	3-500MCM	15KV	1965	2,150	CUT SPLICE & REMOVE
F35	ADF-1-71	OS-2-71-WAY A	DIRECT	3-500MCM	15KV	1965	240	REMOVE
F36	OS-1-70-WAY 2	OS-1-70A-WAY C	EMH 85, 76	3-500MCM	15KV-PILC	1965	240	CUT SPLICE & REMOVE
F37	SW-A1-52-A115	ROD-1-70A	GR SUB VAULT, EMH 10, 11, 8, 9, 7, 3, 4, 75, 77, 76	3-250MCM	15KV	1965	2,450	CUT SPLICE & REMOVE
F38	ROD-1-70A	OS-1-70A-WAY A	EMH 76	3-250MCM	15KV	1965	100	REMOVE
F39	ACB-S115-51	BANK 51	DIRECT	3-#2AWG	15KV	1965	210	REMOVE

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-EXISTING FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	YEAR INSTALLED	LENGTH FT	REMARKS
F40	ACB-S156-51	BANK 53	DIRECT	3-#2AWG	15KV	1965	210	REMOVE
F41	ACB-S157-51	ADF-162-51	DIRECT	3-500MCM	15KV	1965	210	REMOVE
F42	ADF-162-51	ADF-163-51	DIRECT	3-500MCM	15KV	1965	210	REMOVE
F43	ACB-S15-51	EMH 42	DIRECT		15KV		100	REMOVE, CABLE CUT IN EMH 42
F44	ACB-S18-51	BANK 54	DIRECT	3-#2AWG	15KV	1965	185	REMOVE
F45	ACB-S19-51	BANK 55	DIRECT	3-#2AWG	15KV	1965	240	REMOVE

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-NEW FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	LENGTH FT	REMARKS
FBCSS1	SW-A1-52-A104	SW-A6-52-A601	GR SUB VAULT, EMH 118, A THRU J, BCSS CABLE VAULT	6-750MCM 2-#2/0 GND	15kV-EPR	2,350	GR = GRIZZLY BCSS = BALCKBERRY CANYON SWITCHING STATION GND = GROUND
FBCSS2	SW-A1-52-A116	SW-A6-52-A602	GR SUB VAULT, EMH 118, A THRU J, BCSS CABLE VAULT	6-750MCM 2-#2/0 GND	15KV-EPR	2,350	EMH = ELECTRICAL MANHOLE EPR = ETHYLENE PROPYLENE RUBBER
FBCSS3	SW-A6-52-A604	ADF-1-50-1	BCSS CABLE VAULT, EMH 36, 35, 79	3-250MCM 1-#2/0 GND	15KV-EPR	900	
FBCSS3A	ADF-1-50-1	OS-1-70-WAY1	EMH 79, 146	3-250MCM 1-#2/0 GND	15KV-EPR	220	
FBCSS3B	OS-1-70-WAY1	OS-1-70A-WAY C	EMH 146, 153, 154, 155	3-250MCM 1-#2/0 GND	15KV-EPR	450	
FBCSS4	SW-A6-52-A614	ADF-1-50-2	BCSS CABLE VAULT, EMH 36, 35, 79	3-250MCM 1-#2/0 GND	15KV-EPR	900	
FBCSS4A	ADF-1-50-2	OS-1-70-WAY 2	EMH 79, 146	3-250MCM 1-2/0 GND	15KV-EPR	220	
FBCSS4B	OS-1-70-WAY 2	OS-1-70A-WAY A	EMH 146, 153, 154, 155	3-250MCM 1-#2/0 GND	15KV-EPR	450	
FBCSS5	SW-A6-52-A605	ADF-1-55-1	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51	3-250MCM 1-#2/0 GND	15KV-EPR	850	
FBCSS5A	ADF-1-55-1	ADF-1-90-1	EMH 51, 53, 54	3-250MCM 1-#2/0 GND	15KV-EPR	1,120	

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-NEW FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	LENGTH FT	REMARKS
FBCSS6	SW-A6-52-A615	ADF-1-55-2	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51	3-250MCM 1-#2/0 GND	15KV-EPR	850	
FBCSS6A	ADF-1-55-2	ADF-1-90-2	EMH 51, 53, 54	3-250MCM 1-#2/0 GND	15KV-EPR	1,120	
FBCSS7	SW-A6-52-A606	GS-1-50B-A	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51, 48, 49, 59	3-350MCM 1-#2/0 GND	15KV-EPR	900	
FBCSS7A	GS-1-50B-C	ADF-1-50A-1	EMH 59, 49	3-350MCM 1-#2/0 GND	15KV-EPR	500	
FBCSS8	SW-A6-52-A616	GS-1-50A-A	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51, 48, 49	3-350MCM 1-#2/0 GND	15KV-EPR	900	
FBCSS8A	GS-1-50A-B	ADF-1-50A-2	EMH 49	3-350MCM 1-#2/0 GND	15KV-EPR	90	
FBCSS9	SW-A6-52-A607	ADF-1-88-1	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51, 48, 56, 57, 58	3-500MCM 1-#2/0 GND	15KV-EPR	1,750	
FBCSS10	SW-A6-52-A617	ADF-1-88-2	BCSS CABLE VAULT, EXIST. TRENCH, EMH 51, 48, 56, 57, 58	3-500MCM 1-#2/0 GND	15KV-EPR	1,750	

ELECTRICAL SYSTEM REHABILITATION PHASE IV-BLACKBERRY CANYON AREA
15KV CABLE SCHEDULE-NEW FEEDERS

FEEDER NO.	FROM	TO	ROUTING	SIZE	INSULATION	LENGTH FT	REMARKS
FBCSS11	SW-A6-52-A608	ADF-1-51-1	BCSS CABLE VAULT, EXIST. TRENCH	3-500MCM 1-#2/0 GND	15KV-EPR	250	
FBCSS11A	ADF-1-51-1	ADF-2-51-1	DIRECT	3-500MCM 1-#2/0 GND	15KV-EPR	50	
FBCSS12	SW-A6-52-A618	ADF-1-51-2	BCSS CABLE VAULT, EXIST. TRENCH	3-500MCM 1-#2/0 GND	15KV-EPR	250	
FBCSS12A	ADF-1-51-2	ADF-2-51-2	DIRECT	3-500MCM 1-#2/0 GND	15KV-EPR	50	
FBCSS13	SW-A6-52-A609	ADF-1-71-1	BCSS CABLE VAULT, EMH J, I, H, G, 38, 117, 43, 39	3-500MCM 1-#2/0 GND	15KV-EPR	1,170	
FBCSS14	SW-A6-52-A619	ADF-1-71-2	BCSS CABLE VAULT, EMH J, I, H, G, 38, 117, 43, 39	3-500MCM 1-#2/0 GND	15KV-EPR	1,170	

ELECTRICAL SYSTEMS REHABILITATION, PHASE IV
BLACKBERRY SWITCHING STATION REPLACEMENT

ED&I ANALYSIS
($K)

LBL Activities

Engineering

• Title I (6.5 MM at 15.3/mo)				=	100
Proj Eng 1 x 0.42 time x 6 mos	=	2.5MM			
Proj Team 3 x 0.22 time x 6 mos	=	4.0			
• Title II (9.8 MM at 15.3/mo)				=	150
Proj Eng 1 x 0.42 x 9 mos	=	3.8MM			
Proj Team 3 x 0.22 x 9 mos	=	6.0			
• Title III (5.2 MM at 15.3/mo)				=	80
Proj Eng 1 x 0.20 x 18 mos	=	3.6			
Proj Team 3 x 0.03 x 18 mos	=	1.6			
• Inspection (11.1 MM at 15.3/mo)				=	170
Inspectors 1 x 0.62 x 18 mos	=	11.1			
• Consultants				=	40
Geotechnical Report and Inspection			11		
Independent Seismic Reviews			3		
Independent Cost Estimate			2		
Testing Laboratories			13		
Startup Testing			8		
Surveying			3		
					540

A/E Activities 330

7.6% of Designed Construction Costs ($4,620)

	Design Services	Construction Support	Design Support Services	Total	% of Total Fee
Title I	90		10	100	30
Title II	155		5	160	50
Title III		70	0	70	20

245 = 6.0% of Construction Cost

*See attached A/E Fee Proposal Estimate Form

Total Estimated ED&I 880

Current FY95 LBL Rate: $13.2K/MM
Escalation to December 1999 at 16.0%: 15.3K/MM